Amendment to the Claims.

1. (Amended) A process for cleaning a surface of a semiconductor wafer, which comprises:

providing a wafer;

~~a)~~ conveying a component selected from the group consisting of: a dense gas component, a liquid component and a mixture thereof to a bellows accumulator having a bellows therein;

~~b)~~ applying an elevated pressure to said bellows sufficient to discharge said component from said bellows onto said surface of said wafer; and

~~c)~~ contacting said component with said surface of said wafer to clean said wafer.

2. (Original) The process of claim 1, wherein said dense gas component is dense carbon dioxide or supercritical carbon dioxide.

3. (Original) The process of claim 2, wherein said liquid component is an organic liquid component soluble or miscible in dense carbon dioxide or supercritical carbon dioxide.

4. (Original) The process of claim 1, wherein said liquid component is selected from the group consisting of: isopropyl alcohol, hydrofluoric acid, pyridine and combinations thereof.

5. (Original) The process of claim 1, wherein said elevated pressure is applied to said bellows via a compressed gas.

6. (Amended) The process of claim 1, wherein said component is a mixture and said step of contacting said component ~~is contacted~~ with said surface of said semiconductor wafer takes place in a pressure chamber, and further comprising the steps of:

charging said ~~wherein the component charges the~~ pressure chamber with said mixture to a free headspace pressure of about 1000 psia or more, and

discharging said mixture from ~~wherein~~ said bellows ~~discharges said mixture~~ at a flow rate sufficient to impart a mixture ~~component~~ velocity of about 10 cm/sec or more.

7. (Amended) The process of claim 1, wherein said component is a mixture and said step of contacting said component ~~is contacted~~ with said surface of said semiconductor wafer takes place in a pressure chamber, and further comprising the steps of:

charging said ~~wherein the component charges the~~ pressure chamber with said mixture to a free headspace pressure of about 2400 psia or more, and

discharging said mixture from ~~wherein~~ said bellows ~~discharges said mixture~~ at a flow rate sufficient to impart a mixture ~~component~~ velocity next to the wafer surface of about 50 cm/sec or more.

8. (Amended) A process for cleaning a surface of a semiconductor wafer, which comprises:

providing a wafer;

~~a)~~ conveying a dense gas component to a first bellows accumulator having a first bellows therein;

~~b)~~ conveying a liquid component to a second bellows accumulator having a second bellows therein;

~~c)~~ applying an elevated pressure to said first bellows sufficient to discharge said dense gas component from said first bellows onto a surface of said wafer;

~~d)~~ applying an elevated pressure to said second bellows sufficient to discharge said liquid component from said second bellows onto said surface of said wafer; and

~~e)~~ contacting said dense gas component or said liquid component with said surface of said wafer to clean said wafer.

9. (Original) The process of claim 8, wherein said elevated pressure is applied to said second bellows via said dense gas component.

10. (Original) The process of claim 8, wherein said dense gas component and said liquid component are mixed prior to application to said surface of said wafer.

11. (Original) A process for cleaning a surface of a semiconductor wafer, which comprises:

providing a wafer;

~~a)~~ conveying a dense gas component to a first accumulator wherein said first accumulator is a bellows accumulator having a first bellows therein;

~~b)~~ conveying a liquid component to a second accumulator;

~~c)~~ applying an elevated pressure to said first bellows sufficient to discharge said dense gas component from said first bellows onto said surface of said wafer;

~~d)~~ applying an elevated pressure via said dense gas component to said second accumulator sufficient to discharge said liquid component from said second accumulator onto said surface of said wafer; and

~~e)~~ contacting said dense gas component and said liquid component with said surface of said wafer to clean said wafer.

12. (Original) The process of claim 11, wherein said dense gas component and said liquid component are mixed prior to application to said surface of said wafer.

13. (Amended) A system for cleaning a surface of a semiconductor wafer, which comprises:

~~a)~~ a bellows accumulator having a bellows therein adapted to receive and retain a component selected from the group consisting of a dense gas component, a liquid component and a mixture thereof;

~~b)~~ a means for applying an elevated pressure to said component sufficient to discharge it from said bellows onto a wafer;

~~c)~~ a chamber adapted to receive and retain said semiconductor wafer and receive said component.

14. (Amended) A system for cleaning a surface of a semiconductor wafer, which comprises:

~~a)~~ a first accumulator wherein said first accumulator is a bellows accumulator having a bellows therein adapted to receive and retain a dense gas component;

~~b)~~ a means for applying an elevated pressure to said dense gas component sufficient to discharge it from said bellows onto a wafer;

~~c)~~ a second accumulator adapted to receive and retain a liquid component;

~~d)~~ a means for applying an elevated pressure to said liquid component sufficient to discharge it from the second accumulator onto said wafer;

~~e)~~ a chamber adapted to receive and retain said semiconductor wafer and receive said dense gas component and said liquid component.

15. (Original) The system of claim 14, further comprising a means adapted to receive and mix said dense gas component and said liquid component prior to said chamber.

16. (Amended) A process for mixing a ~~liquefied~~ dense gas component and a liquid component, which comprises:

~~a)~~ conveying a dense gas component to a first accumulator wherein said first accumulator is a bellows accumulator having a first bellows therein;

~~b)~~ conveying a liquid component to a second accumulator;

~~c)~~ applying an elevated pressure to said first bellows sufficient to discharge said dense gas component from said first bellows;

~~d)~~ applying an elevated pressure to said second accumulator sufficient to discharge said liquid component from said second accumulator; and

~~e)~~ combining the discharged dense gas component and the discharged liquid component to form a mixture.

17. (Original) The process of claim 16, wherein the second accumulator is a second bellows accumulator.

18. (Original) The process of claim 16, wherein said dense gas component is dense carbon dioxide or supercritical carbon dioxide.

19. (Original) The process of claim 16, wherein said liquid component is an organic liquid component soluble or miscible in dense carbon dioxide or supercritical carbon dioxide.

20. (Original) The process according to claim 16, wherein said liquid component is selected from the group consisting of: isopropyl alcohol, hydrofluoric acid, pyridine and combinations thereof.

21. (Canceled).

RESPONSE

Applicants have amended the specification and claims in response to the Office Action of April 28, 2005 to correct the informalities noted by the Examiner. In particular, pages 4 and 11 of the specification have been corrected. Further, claims 1, 8 and 11 have been amended to provide antecedent basis for "said wafer" and to positively recite the step of cleaning the wafer. Claims 13 and 14 have been amended to positively recite the step of cleaning the wafer. Claim 16 has been amended to correct an informality and more clearly define the present invention. Claims 6 and 7 have been amended to remove confusing language and more positively claim process steps. Finally, claim 21 has been canceled.

In light of the above amendments, it is respectfully submitted that the objection to the disclosure and the rejections of claims under 35 USC 112, second paragraph, have been overcome and it is respectfully requested that such rejections be withdrawn.

The Examiner has rejected claims 1-21 under 35 USC 103(a) as being unpatentable over DeYoung et al in combination with Nishio. The Examiner cites DeYoung et al as disclosing a process and apparatus for cleaning semiconductor wafers using dense carbon dioxide. However, the Examiner recognizes that DeYoung et al does not teach use of a bellows accumulator as presently claims. Therefore, the Examiner relies on Nishio for disclosure of a bellows type pump and accumulator used to transport chemical liquid for various processes, including washing liquid crystal displays. The Examiner then concludes that it would have been obvious "to use the accumulator taught by Nishio instead of the pressure vessel taught by DeYoung et al to obtain the claimed process and system, and to improve the cleaning process". The Examiner reaches this conclusion "because both accumulator and pressure vessel [are] used to elevate the pressure of the cleaning component". In addition, the Examiner suggests that it would have been obvious "to adjust the flow rate to obtain the component velocity as claimed", but does not cite any prior art in support thereof. These rejections are respectfully traversed and it

is respectfully submitted that the present claims are patentably distinct from DeYoung et al in combination with Nishio.

Initially it is respectfully submitted that in order to support a conclusion that a claimed combination is directed to obvious subject matter, either the references must expressly or impliedly suggest the claimed combination or the Examiner must present a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teaching of the references. (See Ex parte Clapp, 227 USPQ 972; PTO Bd of APP INT, 1985.) Further, applicants respectfully submit that obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination. (See ACS Hospital Systems, Inc. v. Montefiore Hospitals, 221 USPQ 929; Fed Cir. 1984.)

In this light, it is respectfully submitted that DeYoung et al and Nishio clearly fail to expressly or impliedly suggest combination. Further, the Examiner has failed to provide a convincing line of reasoning that supports the combination. In particular, it is clear that neither DeYoung et al nor Nishio expressly or impliedly suggests combination. In fact, the two references are directed to very different technologies which makes the supposed combination extremely unlikely. In this light, DeYoung et al relates to method of cleaning microelectronic structures, while Nishio is directed to reducing pulsation in a bellows type pump. It may be true that the Nishio pump could be used in a surface cleaning system, but such use hardly supports the combination suggested by the Examiner. The mere fact that both the DeYoung et al and Nishio systems employ some type of pressure device falls well short of providing the necessary incentive for combination.

Further, even if the references could be combined as suggested by the Examiner, it is respectfully submitted that such combination would not render the present invention obvious. In this light, the Examiner has recognized that DeYoung et al fails to teach or suggest the use of a bellows accumulator. It is respectfully submitted that replacing the vessel of DeYoung et al with the bellows type pump of Nishio would actually render the

DeYoung et al apparatus and method inoperable. In particular, the cleaning process of DeYoung et al, as well as that of the present invention, requires elevated pressures of the cleaning components. Conversely, Nishio discloses use of either a bellows type pump or a bellows type accumulator employed as a pulse dampener to convey a low pressure fluid in a chemical process. The bellows type pump of Nishio is incapable of pumping fluids to high pressure for a number of reasons. In particular, excessive force would be required to move the piston rod 13 if high pressures were present in bellows 7. In addition, the bellows 7 is required to be easily deformable and therefore incapable of containing high pressure without balancing high pressure fluids outside of the bellows 7. Clearly, Nishio does not disclose such an arrangement. Therefore, it is clear one skilled in the art would not look to Nishio, a low pressure system, as a possible combination with DeYoung et al, a high pressure system. Further, even if combinable, such combination would not render the present invention obvious, but would rather result in an inoperable system.

In addition, it appears that the Examiner is asserting that the adjustment of flow rate to obtain component velocity as claimed in the instant claims would be "well known" or a "matter of common knowledge". Further, the Examiner appears to be suggesting that the particular velocities claims would be "well known". This assertion is respectfully traversed, and it is respectfully submitted that the Examiner has failed to meet the "substantial evidence" standard (See MPEP 2144.03) that requires the facts asserted to be well-known be capable of instant and unquestionable demonstration as being well-known. It is not appropriate for the Examiner to take official notice of facts without citing a prior art reference where the facts asserted to be well known are not capable of instant and unquestionable demonstration as being well-known, as is the case here. It is clear that the specific velocities of the present claims is not well known, but rather a specific dependent limitation appropriate for the present invention. If the Examiner continues to apply this rejection, it is respectfully requested that the Examiner provide documentary evidence supporting this allegation as required by MPEP 2144.03.

Therefore, it is respectfully submitted that present claims 1-21 are patentably distinct from DeYoung et al in combination with Nishio and it is respectfully requested that the rejection of such claims under 35 USC 103(a) be withdrawn.

The Examiner has further rejected claims 1-2, 5, 8-19 and 20 under 35 USC 103(a) as being unpatentable over Barton in combination with Nishio. The Examiner indicates that Barton discloses a process and system for cleaning semiconductor wafers, but again notes that Barton fails to teach the bellows accumulator as required by the present claims. Therefore, the Examiner again relies on Nishio for teaching a bellows accumulator for the same reasons as set forth with respect to claims 1-21 and the combination with DeYoung et al noted above. These rejections are traversed and it is respectfully submitted that the present claims are patentably distinct from Barton in combination with Nishio.

The Barton system uses three ballast tanks 36, 38, and 40 that are simple vessels periodically refilled with the dense phase fluid and fluid modifier. Such simple vessels are sufficient in Barton because there is no capability to maintain constant pressure in the process vessel of Barton. In fact, it is actually intended to be able to change the pressure in the process vessel. As noted above, Nishio relates to a low pressure system. There is simply no reason why one skilled in the art would look to Nishio for combination with Barton, and clearly the Examiner has failed to meet the burden necessary for establishing such a combination. The Examiner's statements that "simply alternating choice of tank because Barton discloses that to render the process as continuously efficient as possible ..." fails well short of this burden and in fact makes little if any sense. It is completely unclear why or how the bellows pump of Nishio could be substituted for the ballast tanks of Barton and it is respectfully submitted that such substitution would at best defeat the purpose of the Barton system.

Therefore, it is respectfully submitted that present claims 1-2, 5, 8-19 and 20 are patentably distinct from Barton in combination with Nishio and it is respectfully requested that the rejection of such claims under 35 USC 103(a) be withdrawn.

In light of the above amendments and remarks, it is respectfully submitted that the present application is in condition for allowance and further action consistent therewith is respectfully requested.

Respectfully submitted,

David A. Hey
Attorney of Record
Reg. No. 32,351
TEL (908) 771-6385
FAX (908) 771-6159

Date: 22 September 2005

The BOC Group, Inc.
Legal Services-IP Dept.
575 Mountain Ave.
Murray Hill, NJ 07974